Government of India, The Patent Office, 214, Acharya Jagadish Bose Road, Calcutta-17. Complete specifdation No.142348 dated 8th January, 1976. Application and provisional specification No.2433/Cal/1974 dated 6th November, 1974. Acceptance of the complete specification advertised on 25th June, 1977.

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"A PROCESS FOR THE EXTRACTION OF GALLIUM FROM SODIUM ALUMINATE LIQUORS BAYER LIQUOR OBTAINABLE FROM ALUMINA PRODUCING PLANTS"

Council of Scientific & Industrial Research, Rafi Marg, New Delhi-1, India, an Indian registered body incorporated under the Registration of Societies Act (Act XXI of 1860).

The following specification describes the nature of this invention :-

This is an invention by Rengachariar Srinivasan, Scientist; Gajavalli Nagarajarao Srinivasan, Senior Laboratory Assistant; Alagappillai Varadharaj, Junior Scientific Assistant; Jainulabdeen Ameer Mohaideen Abdul Kader, Technical Assistant; all Indians, and employed in the Central Electrochemical Research Institute, Karaikudi-3.

PRICE RS.2.00

This invention relates to improvements in or relating to the extraction of gallium by deposition onto sodium amalgam from sodium aluminate liquors obtainable from alumina producing plants.

Hitherto, it has been proposed to recover gallium from sodium aluminate liquors obtainable from alumina producing plants, by electrodeposition onto mercury, the current density used being in the range of 0.4-0.7 A/dm^2 or by a process of displacement with sodium amalgam.

This is open to the objection that the former method uses a low current density and hence, the rate of recovery, usually of the order of 0.5 $gm/dm^2/24$ hrs is slow with a consequent higher mercury inventory while the latter method in addition to higher mercury inventory involves two separate reactions, one for preparation of sodium amalgam by electrolysis and the other for reaction with the sodium aluminate liquors.

The object of this invention is to obviate these disadvantages in the extraction of gallium from sodium aluminate liquors by carrying out electrolysis at higher current densities viz., 1.6 to 2.0 $amps/dm^2$.

To these ends, the invention broadly consists in electrolysing sodium aluminate liquors containing 200-300 mg of gallium per litre, 300-400 gm/l of sodium hydroxide and not more than 20 mg/l of vanadium which is a particularly deleterious impurity, using sodium amalgam containing 0.3-0.8% sodium but preferably in the range of 0.4 to 0.6% sodium as the cathode, nickel plated steel as anode, the current density being in the range of 1.6-2.0 A/dm^2 at the cathode, the operating temperature being maintained in the range of 40 to 60°C but preferably around 50°C and the sodium amalgam being stirred with a stirrer having a peripheral velocity around 50 cm/sec.

The following typical examples are given to illustrate the invention:-

EXAMPLE - I

Composition of liquor used:

Gallium	..	300 mg/1
Alkali (sodium hydroxide)	..	398 gm/1
Vanadium	..	20 mg/1

Electrolysis parameters:

Cathode current density	..	1.75 A/dm^2
Temperature	..	50°C
Concentration of sodium in amalgam cathode	..	0.4%
Anode	..	Nickel plated mild steel
Anode current density	..	About 10 times cathode current density
Cell voltage	..	4.0 to 4.5.v
Cathode area	..	1 dm^2
Peripheral velocity	..	50 cm/sec
Percentage extraction of gallium	..	78%
Rate of extraction	..	1.97 $gm/dm^2/24$ hrs

Example-II

Composition of liquor used:

Gallium	..	270 mg/1
Alkali (sodium hydroxide)	..	330 gm/1
Vanadium	..	10 mg/1

Electrolysis parameters: ..

Cathode current density	..	1.93 A/dm^2
Temperature	..	50°C
Concentration of sodium in amalgam cathode	..	0.5%
Anode	..	Nickel plated mild steel
Anode current density	..	About 10 times cathode current deantiy
Cell voltage	..	4.0 to 4.5 V
Cathode area	..	1 dm^2
Peripheral velocity	..	50 cm/sec
Percentage extraction of gallium	..	89%
Rate of extraction	..	1.98 $gm/dm^2/24$ hr.

The following are among the main advantages of the invention:-

1. The rate of extraction of gallium is higher than in the known process by a factor of about 3.

2. The inventory of mercury is lower than for the known processes.

3. The process is also capable of being adopted for a continuous operation.

4. For a given current rating, the time of hold up for the aluminate liquor in circulation is less than in the known process.

Dated this 29th day of October, 1974.

Sd/-
ASSTT. PATENTS OFFICER,
Council of Scientific & Industrial Research

THE PATENTS ACT, 1970.

COMPLETE SPECIFICATION

SECTION 10

"A PROCESS FOR THE EXTRACTION OF GALLIUM FROM SODIUM ALUMINATE LIQUORS (BAYER LIQUOR) OBTAINABLE FROM ALUMINA PRODUCING PLANTS"

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Rafi Marg, New Delhi-1, India, an Indian registered body incorporated under the Registration of Societies Act (Act XXI of 1860).

The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed :-

This is an invention by Rengachariar Srinivasan, Scientist; Gajavalli Nagarajarao Srinivasan, Junior Scientific Assistant, Alagappillai Varadharaj, Junior Scientific Assistant, and Jainulabdeen Ameer Mohaideen Abdul Kader, Technical Assistant, all Indians and employed in Central Electrochemical Research Institute, Karaikudi-3.

THIS invention relates to improvements in or relating to the extraction of gallium from sodium aluminate liquors (Bayer liquor) obtainable from alumina producing plants.

KNOWN electrolytic processes employ a low cathodic current density in the range of 0.4 to 0.9 A/dm^2. The sodium aluminate solutions employed contain less than 200 mg of gallium/litre, less than 200 g/l of sodium hydroxide and about 300 mg/l of vanadium. The mercury amalgam cathode used contain a sodium concentration of much below 0.5% sodium and the sodium concentration is not controlled. Known cementation techniques need two separate reactions, one for the preparation of sodium amalgam by electrolysis and the other for reaction with the sodium aluminate liquor.

DRAWBACKS IN THE HITHERTO KNOWN PROCESSES:

1. Rate of extraction is [illegible] low, of the order of 0.5 g/dm^2/24 h. in known electrolytic processes.
2. In cementation techniques, two separate steps are involved.
3. Both the processes need a higher mercury inventory.
4. These techniques result in a higher mercury loss (5 g/g of gallium extracted).

THE object of this invention is to obviate these disadvantages in the extraction of gallium from sodium aluminate liquors by carrying out electrolysis at higher current densities, viz., 1.6 to 2 A/dm^2, other conditions being chosen appropriately. These other conditions relate to the use of concentrated sodium aluminate liquor obtained in the Bayer cycle as the starting material containing 200 to 300 mg of gallium/litre together with 300-400 g/l of sodium hydroxide and less than 20 mg/l of vanadium and maintaining sodium concentration in the amalgam cathode at 0.5% throughout the electrolysis.

THE rate of extraction of gallium has been increased (by using a high current density) to 1.5 to 2 g/dm^2/24 h.

THE rate of extraction is 4 times (2 g/dm^2/24 h) that of known process and consequently the mercury inventory is reduced by 4 times.

THE present invention consists of a process for the extraction of gallium from sodium aluminate liquors, which comprises in electrolysis of sodium aluminate liquor wherein the liquor used is concentrated sodium aluminate solution and which contains 200-300 mg of gallium per litre together with 300-400 g per litre of sodium hydroxide and a vanadium content less than 20 mg/litre using a nickel plated mild steel anode and a cathode of sodium amalgam with about 0.5% sodium, the current density being 1.6 to 2 A/dm^2 at the cathode, resulting in a higher rate of extraction, viz. 1.5 to 2 g/dm^2/24 h.

EXAMPLE-1

COMPOSITION OF LIQUOR USED

Gallium	..	300 mg/l
Alkali (sodium hydroxide)	..	398 g/l
Vanadium	..	20 mg/l

ELECTROLYSIS PARAMETERS

Electrolytic cell	..	2 litre PVC vessel
Volume of electrolyte	..	500 cb
Cathodic current density	..	1.75 A/dm^2
Temperature	..	50°C
Concentration of sodium in amalgam cathode	..	0.4%
Anode	..	Nickel plated mild steel
Anode current density	..	About 10 times cathode current density
Cell voltage	..	4.0 to 4.5 V
Cathode area	..	1 dm^2
Peripheral velocity of stirrer	..	50 cm/sec
Duration of electrolysis	..	1 hour
Percentage extraction of gallium	..	78%
Rate of extraction	..	1.97 g/dm^2/24 h

EXAMPLE-2

COMPOSITION OF LIQUOR USED

Gallium	..	270 mg/l
Alkali (sodium hydroxide)	..	358 g/l
Vanadium	..	10 mg/l

ELECTROLYSIS PARAMETERS

Electrolytic cell	..	2 litre PVC vessel
Volume of electrolyte	..	500 cc
Cathode current density	..	1.93 A/dm^2
Temperature	..	50°C
Concentration of sodium in amalgam cathode	..	0.5%
Anode	..	Nickel plated mild steel
Anode current density	..	About 10 times cathode current density
Cell voltage	..	4.0 to 4.5 V
Cathode area	..	1 dm^2
Peripheral velocity of stirrer	..	50 cm/sec
Duration of electrolysis	..	1 hour
Percentage of extraction of gallium	..	80%
Rate of extraction	..	1.98 g/dm^2/24 h.

The rate of extraction of gallium is higher than in the known process by a factor of 4.

The inventory of mercury is lower than for the known processes by a factor of 3 to 4.

The process is also capable of being adopted for a continuous operation.

For a given current rating, the time of hold up for the aluminate liquor in circulation is less than in the known process by a factor of 3 to 4.

This invention broadly consists in electrolysing sodium aluminate liquors containing 200-300 mg of gallium per litre, 300-400 g/l of sodium hydroxide and not more than 20 mg/l of vanadium, using sodium amalgam, containing 0.3-0.8% sodium but preferably in the range of 0.4 to 0.6% sodium as cathode, nickel plated mild steel as anode, the current density being in the range of 1.6 to 2 A/dm^2 at the cathode, the operating temperature being maintained in the range of 40-60°C, but preferably around 50°C and the sodium amalgam being stirred with a stirrer having peripheral velocity around 50 cm/sec. The rate of extraction is 2 g/dm^2/24 h and correspondingly the mercury inventory is low.

We claim:-

1. A process for extraction of gallium from sodium aluminate liquors (Bayer liquor) obtainable from alumina producing plants which consists in electrolysis of sodium aluminate liquor containing approximately 200-300 mg of gallium/litre together with 300-400 g/l of sodium hydroxide and a vanadium content of less than 20 mg/l using a nickel plated mild steel as anode and sodium amalgam with about 0.5% sodium as cathode and is characterised in that the cathodic current density is 1.6 to 2 A/dm^2.

2. A process for the extraction of gallium from sodium aluminate liquors as claimed in (1) above wherein the cathode of 0.5% sodium amalgam is stirred by a stirrer at a peripheral velocity of 50 to 60 cm/sec. in order to ensure that the concentration of sodium is maintained uniformly throughout the mercury pool and the rate of extraction kept constant.

3. A process for the extraction of gallium from sodium aluminate liquors ~~[illegible]~~ as claimed in (1) and (2) above wherein the sodium aluminate liquor is maintained at a temperature of 40-60°C but preferably at 50°C in order to ensure that the sodium concentration is maintained at 0.5% and the rate of extraction is kept up at 1.5 to 2 g/dm^2/24 h.

Dated this 30th day of December, 1975.

R. B. Lashkare
Patents Officer,
Council of Scientific & Industrial Research.

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